



EPIC 3.15: REFCL - Objective, Tasks, Metrics

Primary Objective

- Demonstrate REFCL technology for automatically & rapidly reducing the flow of current and risk of ignition in single phase to ground faults in a PG&E's high fire threat district distribution substation.

High Level Tasks

- Phase 1 – Engineering & Construction
 - Project Design, Equipment order, Proof of concept in simulation lab, field construction, training
- Phase 2
 - Commissioning, testing, fault location, final report

Metrics

- Ground fault response
 - Faulted conductor voltage < 1900V within 85 ms
 - Faulted conductor voltage < 750V within 500 ms
 - Faulted conductor voltage < 250V within 2000 ms
 - Measured through field tests using high voltage test resistor
- SAIDI and MAIFI comparisons with PSPS and solid grounding

EPIC 3.15: REFCL - Accomplishments

Key Accomplishments to date

- Design completed
- Ground Fault Neutralizer installed at Calistoga substation
- Proof of concept simulations completed
- Field construction underway
- Training in progress



Internal



EPIC 3.15: REFCL - Learnings

Key Learnings

- Through simulated testing, GFN can detect and mitigate high impedance faults over 14.4 k-ohm
 - This is world class fault sensitivity
- Capacitive balance is critical to REFCL sensitivity
 - New type of equipment: Capacitive Balancing Unit (CBU) to actively balance capacitive currents and maximize fault sensitivity
 - Maintaining capacitive balance through circuit operations is a challenge
 - Fuses clearing Phase-Phase faults can introduce unbalance
 - Mitigated through FuseSavers and group tripping
 - Balance must be maintained through circuit topology changes (i.e. LR tripping)
- Primary connected equipment must be rated to withstand greater voltages during faults
 - Substation voltage regulators
 - Isolation transformer for primary connected customer at landfill
 - Underground cable
- Arc Suppression Coil must be sized with adequate tuning margin (100A coil for project)

EPIC 3.15: REFCL - Next Steps

Next Steps

- Complete construction activities
- Commission GFN and stress test the distribution network
- Perform Field Tests
- Operate circuits with GFN in-service and collect real world data

Path to Production

- Complete feasibility review of 20 substations in high fire threat districts
- Select top 5 substations
- Perform same high level tasks as demonstration project

